

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

Please report the burden for this collection of information by type of burden per response, including the time for review, instructions, searching existing data source, gathering, reliable, etc., and the data needed, and completing and returning the bottom section of this form. Send comments regarding this burden estimate or any other aspect of this collection of information, including its burden, to Washington Headquarters Services, Directorate for Information Operations and Infrastructure, DIA Headquarters, Suite 7740, Washington, DC 20330-4102, Attention: Director, Information Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20330.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED FINAL	
4. TITLE AND SUBTITLE Exact Physical Models and Methods for Stabilization and Control of Reflection-Induced Instabilities in Semiconductor Lasers		5. FUNDING NUMBERS 61102F	
6. AUTHOR(S) Professor Moloney		2304/BS	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of Arizona Tucson, AZ 85721		8. PERFORMING ORGANIZATION REPORT NUMBER AFOSR-TR- 95 0116	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR/NE 110 Duncan Avenue Suite B115 Bolling AFB DC 20332-0001		10. SPONSORING/MONITORING AGENCY REPORT NUMBER F49620-93-1-0306	
11. SUPPLEMENTARY NOTES			
12. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED		13. DISTRIBUTION CODE	
14. SUBJECT TERMS		15. NUMBER OF PAGES	
16. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED		17. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	
18. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED		19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	
20. LIMITATION OF ABSTRACT UNCLASSIFIED			

FINAL REPORT

AFOSR-TR-

95

0114

TITLE: Exact Physical Models and Methods for Stabilization and Control
of Reflection-Induced Instabilities in Semiconductor Lasers

EXECUTIVE SUMMARY : AFOSR Grant No: F496209310306

Professor Moloney University of Arizona - Tucson AZ 85721
The preliminary stage (6 months) of our contract work was focused on incorporating microscopic many-body effects into a full scale simulation code of a semiconductor laser (SCL). The latter includes counterpropagating optical waves in the Fabry-Perot structure, longitudinal carrier diffusion and, importantly, gain and refractive index dispersion derived from a look-up table. Boundary conditions are applied at each end of the cavity and an additional feedback mirror is simple to incorporate allowing us to study the transition from weak to strong optical feedback. This approach enables us to investigate multi-longitudinal mode oscillations and discriminate these from mode-hopping phenomena. Moreover, the response function derived from the many-body theory can be "engineered" to optimize the dynamic response of the SCL. In other words, we can systematically investigate the role of bulk, versus quantum well and strained layer materials on lasing action. When modulated internally (relaxation oscillations, feedback instabilities) or externally (injection current) the dispersion can vary significantly as the carrier density varies.

Fundamental challenges that we are currently facing include a reliable description of the gain/index dispersion as a function of carrier density and proper noise modelling at \approx locations along the laser axis. The former is critical to implementing a computationally efficient algorithm, especially when we extend our study to include transverse diffraction and diffusion at a later stage.

Professor Maxi San Miguel, on sabbatical leave from Spain, is an expert on noise modelling in lasers and is working directly with his student, Marga Homar, on the noise modelling. Professor John McInerney, a consultant on the project, is spending 3 weeks at Arizona in order to provide direct experimental input to our theoretical effort. In particular, we are testing the validity of the Lang-Kobayashi rate equation feedback model against our more elaborate theory. Dr. Ping Ru, the postdoctoral fellow on the project has completed the simulation code incorporating the look-up table and noise effects, and this is now being tested where possible against the known results of simpler rate equation models. Dr. Ru is also setting up a simulation to include the polarization dynamics by integrating the Maxwell-Semiconductor Bloch equations in the quasi-free particle approximation.

We have been in direct contact with scientists at the Phillips Laboratory (David Bossert, an experimentalist at Kirtland AFB) and Vassilius Kovanis (a theorist with a nonlinear optics group). David Bossert spent 6 days at Arizona earlier this month and Vassilius Kovanis visited for 3 days. Our group plans to visit the Phillips Laboratory in late October. We continue to maintain regular telephone, fax and e-mail contact with the Phillips group.

In addition to the listed publications, three papers have been submitted for publication:

Ru, P., et al, Microscopic modeling of bulk and quantum well GaAs-based semiconductor lasers, Optical and Quantum Electronics, 1993

Ru, P., et al, Mean-field approximation in semiconductor lasers, Physical Review A, 1993

Li, H., and McInerney, J.G., Detailed analysis of coherence collapse in semiconductor lasers, IEEE Journal of Quantum Electronics, September 1993.

Accesion For	
NTIS	CRA&I <input checked="" type="checkbox"/>
DTIC	TAB <input type="checkbox"/>
Unannounced <input type="checkbox"/>	
Justification _____	
By _____	
Distribution / _____	
Availability Codes	
Dist	Avail and / or Special
A-1	